Thermophysical Properties of Inhomogenous Structures Measured by a Pulse Transient Method

Ľ. Kubičár,[1,C,S] V. Bohač,[1] V. Vretenár,[1] Š. Barta,[2] and G. Neuer[3]

[1]*Institute of Physics SAS, 842 28 Bratislava, Slovakia*
fyzikubo@savba.sk

[2]*Department of Physics, Faculty of Electrical Engineering and Information Technology, Slovak Technical University, 812 18 Bratislava, Slovakia*

[3]*Institute for Nuclear Technology and Energy Systems, University of Stuttgart, D-70550 Stuttgart, Germany*

Recently a new class of dynamic methods – transient methods- have begun to be used for measurement of the thermophysical parameters of materials. Implementation of these methods in laboratories induces a range of new effects that were found when measuring non-homogenous and non-equilibrium materials. The effect gives the possibility for inspecting the structure and the thermodynamic state of such materials in more detail. This contribution deals with the differences between values of the specific heat, thermal diffusivity and thermal conductivity found by classic methods (adiabatic and drop calorimetry, DSC, guarded hot plate method for measuring thermal conductivity) and by transient ones on composites and porous materials. The pulse-transient method in the temperature range from –30 ^{o}C up to 90 ^{o}C was used for measuring porous aerated autoclaved concrete and from –10 ^{o}C up to 50 ^{o}C for the composite C/C - SiC. Instruments RT 1.02 and RTB 1.01 were used for the measurements. Air, helium and vacuum were used during the measurement of the porous materials with 80% of porosity. Significant differences in specific heat values were found when a different atmosphere was used. Anisotropy in the transport thermophysical properties of the composite was found. The transport parameters induce differences in the specific heat value depending on anisotropy. The effects found are induced by use of the dynamic measuring regime in contrast to classic methods where the equilibrium regime is used for specific heat and the steady state regime for thermal conductivity when non-homogenous materials are investigated. No difference in the thermophysical parameter values exists between classic and dynamic methods for homogenous, isotropic materials. Possible theoretical models are analyzed and arguments supporting these differences are presented.